October 1963 – March 1964

Northeastern	Page
General	NE-1
Fernow Experimental Forest	NE-1
Hubbard Brook Experimental Forest	NE-2
Water year determination	NE-2
Mineral cycling	NE-3
Access tubes	NE-3
New Lisbon	NE-4
Weirs	NE-4
European tour	NE-4
Syracuse	NE-5
Adirondack streamflow	NE-5
Snow interception	NE-5
Soil depth measurement	NE-6
Publications	NE-6
Manuscripts submitted	NE-7

NORTHEASTERN FOREST EXPERIMENT STATION

Division of Watershed Management Research

Semi-annual Report April 1964

GENERAL

Major efforts have been along a number of different lines. Ray Leonard spent the past 6 months at Yale studying forest meteorology under Bill Reifsnyder; George Hart has been calibrating Hubbard Brook Watersheds 1 to 3; Bob Pierce was involved with access tubes and skiis (and a broken leg); at Syracuse, Art Eschner, was winding up his Ph.D. dissertation; Irv Reigner worked on publications and assembled six economical radiometers; Ken Reinhart cut two more watersheds; Jim Hornbeck prepared work plans and manuscripts; Bill Sopper (Penn State), Reigner and Lull worked on the International Symposium on Forest Hydrology (My!); and with due obeisance we each tendered our yearly offering to rating forms, career plans, progress in same, annual programs of work, progress in same, line project reports, and annual reports.

FERNOW EXPERIMENTAL FOREST

We have been busy cutting and poisoning the vegetation on the Upper Half of Watershed 7 and the Lower Half of Watershed 6, in the study described in our last semi-annual report. Silviciding was done with the aid of the Accelerated Public Works Program. The logging is behind schedule and we will not be able to complete the job by the start of the growing season but will finish as soon thereafter as possible.

In connection with this study, we sampled for water contamination from the silvicide operation. Over 1,000 gallons of 2,4,5-T in oil were applied as basal and stump spray over a 2-month period on the two 55-acre watersheds. No water contamination was detected, even though members of the panel who "sniffed" the samples were able to pick out specially-prepared samples containing only 0.5 part per million of spray material.

In another study, Fernow data were re-analyzed to find the frequency of measurements required to determine treatment effects. Results indicated that for some purposes once-a-day or once-a-week measurements of discharge might be substituted for continuous measurement. This analysis was presented at the Hydrologic Data Conference in Ft. Collins in November and will be published as a Research Note.

In analyzing Fernow data, we have utilized a t-test to test significance of single post-treatment observations. This is the kind of analysis reported in Forest Service Research Paper NE-1. Discussion with Hal Wilm and a little additional pencil pushing have demonstrated that this analysis is basically the same as the covariance analysis often used. The "t^2" of the one test equals the "F" of the other. The t-test has one advantage in that values expressed in the basic terms of measurement (such as area-inches) may be easier to grasp than the squared values in the other test.

Jim Hornbeck has been busy evaluating the sources of error in measuring discharge and compiling streamflow records on the Fernow. A Research Note is being prepared on the subject.

Jim has also initiated a snow study to relate snowmelt on Watershed 7, which is being cleared, to discharge. Calibration data will be collected on Lower 7 before clearing in order to evaluate post-clearing measurements.

Fernow climatic data for one growing season have been analyzed using the program prepared at the University of Michigan for the Thornthwaite procedures. The program predicted considerably more runoff than was measured at the weir. A great deal of further study will be needed before we can explain the hydrology involved. As a part of this, we plan to analyze 10 additional years of data in the same manner.

HUBBARD BROOK EXPERIMENTAL FOREST

Water year determination.

In the course of the initial analysis of 6 years of streamflow records for three watersheds, an attempt was made to determine the best water year. Linear regressions of total streamflow upon total precipitation were made for successive 12-month periods. For periods which began when snow cover was building up, precipitation values were adjusted to account for storage in the snowpack. That 12-month period which has the highest correlation between streamflow and precipitation will have minimal year-to-year variation in soil moisture (or groundwater) at the starting date. The results of this analysis are:

12-month period starting on:	Correlation coefficient
January 1	.970
February 1	.985
March 1	.935
April 1	.983
May 1	.983
May 15	.995
June 1	.995
July 1	.962
August 1	.973
September 1	.987
October 1	.975
October 15	.938
November 1	.906
December 1	.980

It appears that the best water year for this locality starts either on May 15 or June 1 and not in late fall as is used by the Geological Survey. The higher correlation in late spring suggests that by this time soil moisture reaches an upper limit and that, from year to year,

the amount of water in soil storage is most uniform at this time. The correlation coefficients for any water year are quite high, thus indicating that streamflow responds quickly to precipitation. This is attributable to our generally shallow soils, perhaps zero to twenty feet deep, the distinct and absolute separation zone between the soil mantle and the tight underlying bedrock (virtually unweathered), and to the low soil moisture storage capacity of the coarse-textured and stony soils. This preliminary study makes us hopeful that a good calibration can be obtained among watersheds in this locality, and that effects of treatment will be readily detected.

--George E. Hart, Jr.

Mineral cycling

The cooperative study with Dartmouth College is yielding some interesting results concerning the mineral balances of a watershed on the Hubbard Brook Experimental Forest. Chemical analyses of water samples have been done by Dartmouth College for almost a full year. Preliminary results indicate that the export of various ions during periods of low flow, i.e., non-storm periods in summer, is small. For instance, 5.30 kg of Ca^{++}, 1.66 kg of Mg^{++} and 0.21 kg of K^{+} were lost from watershed No. 1 (29 acres) via streamflow during July and August 1963. With increased streamflow during November, the export of Ca^{++}, Mg^{++} and K^{+} increased to 63.18 kg, 19.53 kg and 18.01 kg respectively. It is interesting to note that the potassium export was relatively much greater during the initial period of high flow in November. Since leaf fall had occurred, this suggested that substantial amounts of potassium may be retained in falling leaves, but is quickly leached by rain and carried out of the system via the drainage streams.

--F. H. Bormann
G. E. Likens
N. M. Johnson
R. S. Pierce

Access tubes

A method has been developed to install the access tubes for our neutron probe in our extremely rocky soils. First an Oakfield hand soil auger (1¼ inches diameter) was used to find a suitable spot void of interfering granitic boulders. We then employed a borrowed (from Bill Sopper at Penn State) power drive soil auger (2 inches diameter) to enlarge the hole. The power auger in many cases was able to push aside small rocks and bull its way down to a suitable depth, 4 to 5 feet. A specially designed orchard type auger was used to clean up the hole prior to inserting the 2-inch diameter aluminum access tubes. Between 20 to 40 probe attempts were necessary to get a satisfactory hole. Needless to say, this technique is not very sound in a statistical sense because of the gross bias introduced by avoiding areas with restricting rocks. On the other hand, because our soils are so rocky, this seems to be the only practical method for determining soil moisture. We, of course, must consider this bias in our calculations of soil moisture.

--R. S. Pierce

NEW LISBON

Most of our time this past semester was devoted to manuscripts. Gradually, the data collected during the calibration period at Dilldown is being analyzed and published. The calibration paper finally saw daylight early in 1964 and several related papers are in process. A short note describing an inexpensive wind-movement recorder is ready for publication, and a longer paer on the measurement and estimation of riparian water loss has been reviewed and is now being polished.

A short paper describing the water contamination study (spraying streamside vegetation with phenoxy herbicides) was presented at the annual meeting of the Northeastern Weed Control Conference. To our extreme surprise, the paper received a "Best Paper" award. Besides a certificate inscribed to Irv Reigner (the senior author), there was a cash stipend of $100 which was divided between the two co-authors, Bill Sopper and Roy Johnson. A more complete paper on the same study has been written for the Journal of the American Water Works Association.

Weirs

A bit of trouble with our first vinyl-lined weir and a lot more trouble with a concrete weir has developed during the last year. The vinyl liner of the wooden weir (described in a recent Journal of Forestry Note) is beginning to deteriorate above the water line. The liner was installed in 1959 and is now almost 4 years old. Small slits have appeared; apparently the vinyl is hardening and cracking.

As sunlight is reckoned to be the worst enemy of vinyl plastic, covers have been put on all the vinyl-lined weirs to slow the process of deterioration. A by-product of the weir covers has been a greatly reduced ice formation this past winter. Ron Singer, the Baltimore watershed forester, estimates the ice formation was only one-third the usual thickness. Covers were installed on two of the weirs after ice had formed, and the thickness decreased considerably thereafter.

The covers are extremely simple--merely boards laid from wall to wall across the top of the weir box. They are by no means weathertight and no provision has been made to prevent air movement from either end of the weir. Thus, considerable more refinement to the covers can be made if it appears necessary or desirable.

More serious trouble has developed at the No. 2 weir at the Newark Watershed. Leaks through the concrete box have become large enough to carry the normal flow of the stream. Thus, our record from this watershed has been lost for some time. We plan to line all of the Newark weirs with vinyl sheets this summer when streamflow is at manageable levels.

European tour

While on a tourist-type tour of a number of European countries with his wife last fall, Irv Reigner visited a number of foresters

engaged in hydrology research. Dr. Holstener-Jorgenson, of the Danish Forest Experiment Station at Springforbi, was one of his hosts in Denmark. He is in charge of a water-balance project using plots which are natural lysimeters. The soil has a heavy layer of impervious clay. Runoff, including percolation seepage, is collected and measured in drainage ditches.

In Copenhagen, Reigner visited the designer of a neutron-scattering soil moisture meter. He claimed several advantages, particularly better depth resolution, of his meter over meters manufactured in the United States. His company also designed a gamma-ray meter under a contract with the University of Copenhagen. The instrument works satisfactorily, he said, but is very delicate and difficult to operate. He was much more enthused with the neutron meter, which is in commercial production.

In England, Dr. Leonard Leyton of Oxford University very kindly set up a 4-day tour of hydrology research projects in the region around London. They have only recently become concerned with water problems and are attacking the subject mainly with plot studies and fundamental research. Their work with catchments (experimental watersheds) is just beginning.

--Irv Reigner

SYRACUSE

Adirondack streamflow

Summaries of this summer's and fall's field data, gathered to describe the past and present composition and characteristics of the forest stands on the Sacandaga River watershed, indicate some surprising relationships; apparently the 1950 hurricane caused more widespread, significant and selective changes in the composition of the stands on the watershed, than is indicated by most reports of the storm. The greatest damage was to old, slow-growing, coniferous (chiefly red spruce) stands and to the larger conifers in mixed stands. Mortality among the spruce continues at an apparently higher-than-normal rate. Streamflow analyses of the period from 1912 to 1950 showed a significant decrease over the 39 years in annual and dormant season streamflow (most of it due to a change in the late winter-early spring snowmelt runoff pattern); there was no detectable trend in the growing season streamflow for this period. No well defined, regular pattern of streamflow related to time has been re-established since the storm, in spite of a variance smaller than in the preceding period.

Snow interception

Field work and progress has been very slow on a little study aimed at determining the amount of snow intercepted by coniferous crowns and the ways in which it eventually disappears. Copper tubing made into micro-snow samplers proved to be unsatisfactory; after some searching, clear, capped, plastic tubes 3/8 inch in diameter treated with a silicone water repellent were selected. Then we hit tough sledding--no snow (to speak of) in January and February. Also, the wind in a sheltered

spot at the Forestry College Experiment Station was apparently stronger than anticipated--it blew over all the 6-feet-tall cut conifers on which the intercepted snow was to be weighed and measured. No significant results are expected from this study this year.

Soil depth measurement

Dr. Albert Leaf, Associate Professor of Silviculture at the New York State College of Forestry, has purchased a heavy duty 2-inch soil sampler from the Acker Drill Company and a Michimho Vibroground soil resistivity meter. The soil sampler is a pile-driving device consisting of several hundred pounds of pipe and weights designated "light-weight and portable". The sampling tubes are hinged and open to release the thin-walled soil container. He intends using the resistivity meter to try to detect and map out layers of soil of different texture and moisture content on the sand plains on the College's Pack Forest near Warrensburg. The Michimho is expected to be effective to depths up to 30 feet. The soil sampler, which will be used to obtain control data at intervals, will help interpret the resistivity readings; it will be able to sample to approximately the same depths as the resistivity meter.

If this combination works, it may be used to gather continuous soil depth, structure, and texture information which will be extremely useful in planning research and interpreting watershed results. Art Eschner hopes this equipment does the job since he is partly responsible for the College's getting it.

--Art Eschner

PUBLICATIONS

Forest influences research by questionnaire. Howard W. Lull. Jour. Forestry 61: 778-782. 1963.

Watershed management research. G. R. Trimble, Jr. Amer. Pulpwood Assoc. Tech. Paper 63-P-3. 6 pp. 1963.

Snow deposition and melt under different vegetative covers in Central New York. A. R. Eschner and D. R. Satterlund. U.S. Forest Serv. Res. Note NE-13, 6 pp., illus. Northeast. Forest Expt. Sta. 1963.

Calibrating a watershed by using climatic data. Irvin C. Reigner. U.S. Forest Serv. Res. Paper NE-15, 45 pp., illus. Northeast. Forest Expt. Sta., Upper Darby, Pa. 1964.

Water quality and soil erosion as affected by logging in steep terrain. J. W. Hornbeck, and K. G. Reinhart. Jour. Soil and Water Conserv. 19: 23-27. 1964.

Effect of a commercial clearcutting in West Virginia on overland flow and storm runoff. Kenneth G. Reinhart. Jour. Forestry 62: 167-171. 1964.

What's new in municipal watershed management. Howard W. Lull and Donald R. Satterlund. Proc. Soc. Amer. Foresters 1963 Meeting: 171-175. 1964.

Manuscripts submitted:

Evaluation of the trough-type rain gage. Irvin C. Reigner.

Control of riparian vegetation with phenoxy herbicides and the effect on streamflow quality. Irvin C. Reigner, William E. Sopper, and R. R. Johnson.

Forest watershed research by the U. S. Forest Service in West Virginia. Kenneth G. Reinhart.

How to make a wind-measurement recorder from any space drum-type recorder. Irvin C. Reigner.

Snowmelt studies on the Tully Forest in Central New York. Donald R. Satterlund and Arthur R. Eschner.

Frequency of streamflow measurements required to determine forest treatment effects. Kenneth G. Reinhart.

Some recent results from forest watershed research. Howard W. Lull.

Will the use of phenoxy herbicides contaminate public water supplies? I. C. Reigner, W. E. Sopper, and R. R. Johnson.

The importance of dew in watershed management research in West Virginia. James W. Hornbeck.